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The American FERTILIZER

Vol. 108 MAY 29, 1948 No. 11

Nature and Problems of Fertilizing in Modern Times*

By PROFESSOR D. K. SCHARRER

Director, Institute of Agricultural Chemistry, University of Giessen, Germany

(Continued from the issue of May 15, 1948)

Part II. The Importance of Sorption Carriers

THE newest results from research covering the nature of inorganic and organic sorption carriers and the selective sorption of individual ions are of fundamental importance to the process of base exchange, and therefore to modern fertilizing practices also.

We are mainly indebted to the work of Schachtschabel (*36*) for recognizing that the most important inorganic sorption carriers besides the soil colloids are, in the first place, the so-called clay minerals, such as quartz, the minerals of kaolin, mica and montmorillonite, and the micas. In the past, we believed that nutrient cations were evenly divided throughout all soil colloids, but lately Schachtschabel has shown that the ions are unevenly taken up by the sorption complexes. Potash and ammonium ions in soils, just as the hydrogen, aluminum, and iron ions, are largely bound to the minerals in the mica group; the calcium, magnesium, and also hydrogen, iron and aluminum ions to the humic acids; whereas montmorillonite can adsorb calcium and magnesium ions as well as potash and ammonium ions. Mica may thus be considered as the concentrated carrier of potash ions in soil. The less cations take part in the ion coverage, *i. e.*, the lower their degree of saturation, the more firmly are they bound. Through the binding of potash ions to micas, those ions are more easily taken up by plants than if they were evenly distributed throughout the total soil colloids. Therefore, should a soil contain only montmorillonites as the sorptionable substance, the potash could not readily be utilized. Vice versa, the calcium and magnesium ions are only loosely attached to micas and they can therefore readily be leached from soils in which sorption is mainly accomplished by micas. Furthermore, calcium damage may be expected when the sorptionable portion of soil colloids consists preponderantly of micas. Soils, therefore, should contain certain amounts of montmorillonites and humus, besides firmly bound calcium and magnesium ions. For the determination of the selective sorption of individual ions through the clay minerals, a mixture of solutions of barium-chloride and magnesium-chloride in a ratio 1:1 proved more useful than one used at first by Schachtschabel, which consisted of a solution mixture of calcium and ammonium acetate. It is possible to determine the sorption-part of micas in

* Translated from *Chemiker-Zeitung*, Vol. 68, No. 5, pp. 75–93—(May, 1944) and made available by The Alien Property Custodian. Translators—J. F. Wischhusen, Director, Manganese Research and Development Foundation and Vincent Sauchelli, Director, Agricultural Research, The Davison Chemical Corporation.

addition to those of kaolins and montmorillonites in mixtures of these minerals, by washing such a mineral mixture with a solution of barium and magnesium-chloride and then ascertaining the adsorbed ions through standardized solutions. The organic sorption carriers should, however, first be removed through oxidation with 15 per cent hydrogen peroxide (*37*). The sorption portion of humus in black earth amounts to 40 to 50 per cent, that in montmorillonites to 25 per cent, and in micas likewise to 25 per cent. We can, therefore, take for granted that an optimal sorption is furnished when the sorption-portions of humus amount to 50 per cent and that of micas and montmorillonites each to 25 per cent of the total sorption.

The research results show the great importance of clay minerals and humin materials as sorption carriers for plant nutrients, and therefore also for a controlled fertilizing program. We see how the adhesion and availability of plant nutrients depend essentially upon the structure of organic and inorganic soil colloids.

Soil Building and Soil Depletion

Our fertilizer materials must be so conditioned that whenever possible they furnish not only nutrients for plants, but also furnish soil building qualities, thus simultaneously taking over the functions of *soil fertilizer* materials. We can therefore divide commercial fertilizers into three groups according to a scheme set up by Kappen (*38*), viz.:

(a) Soil depleting or soil degrading;
(b) Soil maintaining or soil preserving;
(c) Soil building or soil improving fertilizer materials.

In the group of soil depleting materials belong ammonium salts, and urea; for soil maintaining purposes, potash salts, superphosphates, potash- and sodium-nitrates; for soil improving, calcium nitrate, dicacium phosphate, rhenania phosphate, Thomas phosphate, and calcium cynamid. When applying soil depleting fertilizers, special attention must be paid to the calcium condition of the soil in question, and also, when using soil preserving fertilizers, an adequate calcium supply must not be neglected.

In the final analysis, the quality of fertilizers, whether in effect soil building or soil depleting, can be traced back to their calcium content, or respectively to the physiological alkalinity or acidity. The physiological alkalinity of a fertilizer material is only of real value for soil preservation when calcium ions play the chief role as a base-building ion.

With each application of mineral fertilizer salts, consideration should be given to cations and anions of the respective mineral fertilizers, how on the one hand they affect the plant, on the other, react upon the soil. It is naturally impossible to furnish one ion by itself, so that the counter-ion (anti-ion) with which the nutrient ion is supplied, is important.

The effect of potash fertilization upon plants and soil depends consequently on the anion with which the potash ion is in each case accompanied, and this phenomenon is equally important in fertilization with nitrates and ammonium salts. In the sense of making an effort to maintain soil fertility and the improvement of crop qualities, it will be necessary today more than in the past to pay attention to the fellow-ions and their effect upon soil and plant. The fertilizer industry, it will be remembered, has for years paid attention to these scientific requirements by producing concentrated mineral fertilizers, so-called free of inert fillers, salts, the cations and anions of which influence plant and soil in the most favorable manner possible. Through a combination of highly and poorly soluble phosphates, or ammonium and nitrate ions in certain fertilizer materials, it has been possible to obtain slowly available but lingering, or quickly available but temporary nutrient effects. Simultaneously, through the introduction of calcium compounds, acid effects became avoidable, and soil building or at least soil preserving fertilizer materials were obtained. To mention a few, viz.: calcium ammonium nitrate (Cal-Nitro) or nitro-calcium phosphate, "Nitrophoska, calcium containing," and calcium urea. Whether the amounts of calcium added to these mineral fertilizers suffice actually to fit the requirements of physiological-alkaline fertilizer materials is another question, which here cannot be discussed further (*39*).

Water Economy

Ions supplied by fertilizer materials have a very great influence upon the water in plants and soil. These ionic effects are essentially dependent upon the charge and degree of hydration of the ions.

Potash ions, being hydrophilic, promote the water uptake, but reduce transpiration; therefore, they produce favorable water conditions (*40*) within the plant. But because a potash ion cannot be furnished by itself alone, the effect of potash fertilizers upon the water content of plants depends actually upon the anions with which it may be associated. There is, therefore, a difference

whether the anion concerned is an hydrophilic chloride ion, whose hydrophilic property is similar to that of the potash ion, and whether it enhances its dynamic effect upon the water economy; or whether it is a sulphate ion which as a hydrophobic ion impairs the uptake of water by the plant and promotes transpiration, thereby creating unfavorable water conditions for the plant. Calcium ion is likewise a hydrophobic ion, and is therefore antagonistic to potash ion in the water economy of plants; it impairs water uptake, promotes transpiration, and therefore is detrimental to plant water similarly to the sulphate ion. Magnesium and sodium ions occupy a place midway between potash and calcium ions insofar as their effect concerns plant water. We are therefore in a position to influence the dynamics of water economy within certain limits through suitable mineral nutrition of plants. This was shown by the work of K. Schmalfuss (*41*) regarding the effect of different fertilization upon the quality of fats, a subject still to be discussed. Liberal potash fertilization increases the hydration of plasma colloids in consequence of the relatively high hydration ions of potash, and therefore renders dehydration difficult. For all practical purposes this means that a plant well supplied with potash more easily withstands lower temperatures than plants poorly supplied with this nutrient.

The water economy of soil itself can be influenced through fertilization. Total soil water, according to research work by Seckera (*42*) falls into three component parts, viz.:

(1) The water hydration of sorption soil complexes;
(2) The hygroscopic water;
(3) The capillary water.

The critical point for the supply of soil water is that at which the supply to plants ceases, and also the prevailing water yield, by which is meant the quantity of water which may be removed in one hour from each cm.(*3*) of soil. To ascertain the nutrient content of soils and the nutrient supply to plants, it is important to find the water yield. Fertilizing will influence very largely the water supply of plants. Sodium ions increase the water yield of soils by reason of their low hydration, and they lower their critical water content. The effect of suitable fertilization upon the water yield of soils may be of practical importance in combating wilt due to dry spells, but, of course, only within certain limits.

Part III. The Major Nutrient Elements

Ammonium or Nitrate Ion

THE old agricultural chemical problem, whether ammonium or nitrate ion, is more suitable for the nitrogen nutrition of the higher plants may be regarded as solved. Hydroponic experiments with nutrient solutions of a constant *p*H number, somewhat according to the so-called flowing-water culture, have shown (*43*, *44*) that the nitrate ion is favorably effective within a much wider reaction range, viz.: between a *p*H 3 and 5, than the ammonium ion whose optimum effect lies between the comparatively narrow range of *p*H 5 to 7. Ammonium ion is most effective under mild acid conditions, but nitrate ion can not only function thereunder but also under severe acid as well as severe alkaline conditions. The investigations of Pirschle (*44*) disclose that ammonium salts especially promote the uptake of phosphoric acid; and nitrates, the uptake of potash.

The fact that ammonium salts react physiologically acid, nitrates physiologically alkaline, gives a certain confirmation to the so-called Robbins effects (*45*) that hydrogen ions promote the uptake of anions, whereas the uptake of cations is promoted by OH-ions. Furthermore, it must be remembered that after ammonium ions are taken up by plants they can, through simple dehydration and the consumption of relatively small amounts of energy, be converted more easily to the amino group, which are so essential to the formation of amino acids, than would be the case with nitrate ions, which would have to be substantially reduced, involving the utilization of comparatively much energy. This is in harmony with practical experience, namely, that, of equal quantities of nitrogen used, ammonium salts are utilized better than the nitrates. The earlier conception that the higher plants were able to utilize only nitrate ions has therefore become untenable.

Much of our valuable, essential, and purely scientific knowledge about the nitrogen nutrition of plants is relegated into the background under practical conditions because soil reactions and plant preferences for certain reaction conditions must be taken into consideration.

On soils weakly acid and for acid-loving plants, as for instance oats, potatoes, and rye, ammonium salts are to be preferred; whereas for acid-sensitive plants, as for instance beets, barley, and wheat, nitrate-nitrogen is to be preferred. Further, ammonium salts used as fertilizers on normal,

healthy soils are very quickly converted into nitrates through the nitrifying activities of bacteria; the nitrate ion taken up by the plants is again reduced to the ammonium form by the plant so that, as an amino group, it can enter into organic combinations.

There is need for more particular research on the effect of different forms of nitrogen fertilizer upon the biology of soils and upon individual crop plants. This is especially necessary with respect to their formation of nitrogen fractions. It is also necessary to learn more about the transformations of the various nitrogen fertilizers in soils, as was done in an exemplary manner by K. Schmalfuss (*4*) in his work on calcium cyanamid referred to earlier. Practical agriculture is particularly interested in the importance played by the time of application and the quantities of nitrogen which can advantageously be applied to agricultural and garden crops. For many purposes it would be advantageous to have at our disposal mineral nitrogen fertilizers which are in more slowly available and lasting forms than those now obtainable.

The Importance of Phosphoric Acid

It is well known that phosphoric acid is a material present on our planet only in comparatively small quantities, and Europe in particular has not been richly endowed with it. The securing of sufficient phosphate sources and the correct disposition of the phosphate fertilizer materials at our disposal are of paramount importance. Under the discussion on soil reactions it has already been pointed out that the calcium content of soil determines the efficiency of phosphates for phosphorus-deficient soils. Exact knowledge is therefore necessary regarding requirements of our soils through the types of investigation already referred to. Research work should further be diligently fostered on the effect of phosphate fertilization upon the individual phosphorus fractions, such as phytin, phosphatide, and nucleo-proteins, because in such (*46*) knowledge lies essentially the solution to the problems of how to influence quality in the crop. In the field of phosphoric acid fertilizer materials it is desirable to obtain more intensified effects through their use than are achieved at present (*47*).

Fertilizing and Crop Quality

The effect of potash fertilization upon soil fertility, crop yields and crop quality depends every time upon the composition of the potash fertilizer material used, whether the potash ion is furnished as the chloride or sulphate ion. Consequently, a series of questions arises as to how potash fertilization will influence crop quality.

Alten, Rauterberg and Loofmann (*48*) already have discovered definite effects from potash upon the nitrogen economy of plants. Liberal potash nutrition for potato plants resulted in more arginin in the tubers, according to Alten and Orth (*49*). This amino acid exercises a poisonous effect upon the spores of phytophthora infestans, so that potash fertilization leads to a resistance of potato plants to this leaf rot. Certain fertilizer potash salts contain magnesium so that the problem of magnesium fertilization is closely tied to current questions about potash fertilization (*50*). Newer investigations have definitely demonstrated that for the production of optimum quantities and quality a supply of magnesium is necessary, especially in the case of fat- and oil-yielding plants, and also for many fibre plants, for instance hemp (*51*) which has shown a high requirement of magnesium. Chloride and sulphate anions produce a far-reaching effect upon the quality of vegetables, which was shown more particularly by Schuphan (*52*).

There is no question but that such problems bearing on quality are among the most important among modern fertilizer questions. For our supply of albumin and fats, it is necessary to know how the albumin and fat contents of plants can be altered. In this field, also, belong problems of how to influence crude fiber and vitamin content of plants through fertilization (*53*)—questions which are important from the viewpoint of animal and human nutrition.

The relationship between nutrition factors of oil-bearing plants and the composition of oils have been explained principally by K. Schmalfuss (*41*) in connection with flax plants.

Linseed oil consists mainly of mixtures of glycerides from three fatty acids, viz.: oleic, linolic, and linoleic acids, of which the oleic molecule forms one double-bond, whereas linolic acid has two and linoleic acid three double-bonds. However, there is no constant ratio between these three unsaturated fatty acids in the composition of linseed oil. Instead, this varies according to the kind and origin of the flax plant over a wide range. Schmalfuss' starting problem in his investigations covered the possible alterations in the composition of linseed oil as a result of varying the nutrition of flax, under otherwise identical conditions. Since the degree of saturation of linseed oil is easily determined

(Continued on page 26)

Davison Expands Phosphate Facilities

The Davison Chemical Corporation has announced plans for the construction of an addition to its phosphate recovery facilities at its phosphate rock mine, near the city of Bartow, Fla., to cost in excess of $500,000. Present plans call for operation of the new unit by January 1, 1949. The unit includes a flotation concentrates plant, utilizing the most recent technical developments to recover very fine sized phosphate rock and thereby substantially increasing both the productive capacity and efficiency of the existing facilities.

Sharp Joins Spencer Chemical Staff

Spencer Chemical Company has announced the affiliation of Joe C. Sharp with is organization as Technical Service Representative, effective as of February 1, 1948.

Mr. Sharp has been associated with the fertilizer industry for a good many years and was formerly with Swift and Company of Atlanta, Georgia, and Wilmington, North Carolina, and has also been associated with International Minerals & Chemicals Corporation at both Buffalo, New York, and Wilmington, North Carolina, as plant superintendent.

New Nitrate Field to Be Opened in Chile

The Lautaro Nitrate Company, a British company, has been authorized by the Chilean Government to open a new nitrate of soda field in North Chile. The new territory, about 600 square miles in extent, is near the company's Pedro de Valdivia plant and contains about 175,000 tons of nitrates which can be extracted commercially. The company is to pay the government about $140,000 for the mining rights and the lands revert to the government after 20 years.

Bemis Establishes Cleveland Sales Office

A new sales office headed by Neely J. Leake has been established in Cleveland by Bemis Bro. Bag Company in order to afford better service to customers in Northern Ohio. Mr. Leake is assisted by Robert C. Thomas, a sales representative, and Miss Dorothea Haggerty who is the Cleveland office manager.

Mr. Leake has been with Bemis for 28 years, having joined the organization at the Indianapolis plant immediately following World War I. After spending his first year in the office he started selling in the Northern Ohio area.

Mr. Leake is an aviation enthusiast and has been flying his own airplane for many years both as a hobby and for business trips. His first sales trip by air was in 1929 and later, in 1938, he introduced airplane crop dusting into Ohio.

International Superphosphate Association Holds Annual Meeting

The International Superphosphate Manufacturers' Association held its annual series of meetings in Brussels, Belgium recently, when some 200 delegates and members of their families were present, representing 25 countries.

Delegates were entertained by the Belgian Superphosphate Producers, by the Municipality of Brussels at the historic Hotel de Ville and by M. van der Rest, Vice-President of the Florida Hardrock Export Association.

At the banquet, given by the Belgian producers, a number of Belgian and foreign dignitaries were present, including the Belgian Minister of Agriculture, who paid tribute to the efforts of the fertilizer industry in assisting world recovery.

The Association has decided to increase its scientific work and to co-ordinate, as far as possible, experiments in connection with the use of superphosphate in its various member countries.

For the year 1948–49 the following officials were elected:

A. Waller, Holland, president. Vice-presidents: R. Audouin, France; F. G. Calvering Fison, United Kingdom; H. Francke, Sweden; R. Standaert, Belgium; H. Stevenius-Nielsen, Denmark. R. M. Collins, secretary.

The Association's membership now comprises manufacturers of superphosphate in 26 countries, and its honorary members include the principal producers of the raw materials for the industry throughout the world.

The Danish members have invited the Association to hold its next meetings in Copenhagen during May, 1949, and the Italian members have invited the Technical Committee to arrange its next meeting in Italy, which is expected to take place in the autumn of 1949, when technical subjects will be discussed, papers presented and visits paid to works.

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Principal Articles in This Issue

Fertilizer Handling Costs Being Reduced

Handling costs in the fertilizer industry can be cut up to 50 per cent through the introduction of modern, high speed mixing and bagging equipment, according to D. M. Weatherly, chemical engineer, John J. Harte Company, Engineers and Constructors, Atlanta, Georgia.

As a result, Mr. Weatherly said, the fertilizer industry in the South is undergoing one of the greatest modernization periods in its history. He added that many established fertilizer plants are also increasing their capacity in order to meet the current demand.

"Southern fertilizer producers have had several very profitable years," Mr. Weatherly said, "and they desire to use a part of their profits to reduce the cost of production to meet the competitive market in the future. They have found through engineering studies that one of the most effective methods of accomplishing this is through the mechanization of handling facilities."

Mr. Weatherly cited as an example a recent installation for a fertilizer producer in one of the Southeastern states, where labor costs were reduced to one-half their former rate. This involved the installation of a new bagging and mixing machine which enabled the owners almost to double their capacity per man hour of labor.

The new equipment will either mix or bag 60 tons of mixed fertilizer per hour with a staff or 30 men, whereas existing equipment bagged less than 30 tons of fertilizer per hour with 25 men in attendance.

Mr. Weatherly also disclosed that many fertilizer firms are now installing up-to-date dust collecting equipment in their plants. This equipment maintains better working conditions, and is another means of obtaining greater production per man hour.

"Southern fertilizer producers are studying costs very carefully," Mr. Weatherly said. "This subject is becoming increasingly important due to the large number of fertilizer plants located in the Southeast which are competitive with each other in their particular location. Due to present shortages of fertilizer materials, and particularly nitrogen, this competition will continue. Since the South is the greatest user of fertilizer of any section of this country, it is absolutely necessary for owners of southern plants to produce as economically as possible so that the market will not go to outside competitors."

Nitrogen Shipments Abroad Most Economical Food Relief

Shipping nitrogen fertilizer abroad instead of wheat can be expected to save the American taxpayer as much as $256,000,000 this year, according to a study released by the American Enterprise Association, 4 East 41st St., New York City.

The quarter-billion dollar saving results from the fact that one ton of nitrogen produces 12 to 15 tons of grain abroad. "With nitrogen at $200 per ton and wheat at $86 per ton, each ton of nitrogen shipped abroad represents a saving of $800."

The 28-page study, entitled "Effect of Purchasing Fertilizer for Shipment Abroad" by Kenneth P. Sheldon of the Association staff, was prepared at the request of Representative Christian A. Herter for the use of the House Select Committee on Foreign Aid and is now being released for general distribution.

Warning that one poor crop year in the United States could "completely upset world food calculations," the study emphasizes the importance of fertilizer in restoring food production abroad and as a means of sharing the risk of unfavorable crop weather.

"There is a severe shortage of nitrogen for fertilizer purposes in Europe, where production is held back by a restricted supply of coal and the condition of the plants." To alleviate a world-wide nitrogen shortage the study recommends "stepping up production in Germany and Japan and Army-owned plants in the United States."

Regarding the war-built U. S. Army plants which are producing about 260,000 tons annually, the study points out that "lack of funds has prevented plant improvements which would add 112,000 tons per year to Army production." The report recommends that the Army press for renovation funds, and at the same time turn over the plants to the War Assets Administration for sale or lease to private industry.

The study concludes that fertilizer shipments to foreign countries "have had no apparent influence on price." On the contrary, such shipments abroad produce "a substantial indirect saving to the American both as a consumer and a taxpayer by reason of lower prices resulting from more adequate foreign production of food."

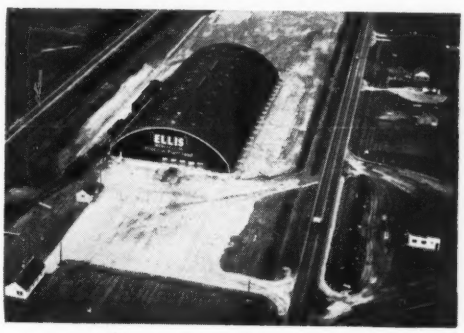
The fertilizer report is seventh in a series dealing with basic commodities involved in the European Recovery Program.

Full Weights Delivered in North Carolina

North Carolina farmers are getting full measure in all but a few of their fertilizer bags, according to C. D. Baucom, superintendent of the weights and measures division of the State Department of Agriculture.

He based this statement on reports submitted by inspectors after completing a spring spot check of fertilizer weights. The inspectors reported weighing 2,215 bags, the products of 36 fertilizers manufacturers, at 193 different distributing points, and finding only 62 bags, or less than three per cent, to be short weight. These were removed from sale.

"This reflects well on the fertilizer manufacturers," commented Agriculture Commissioner D. S. Coltrane when informed of the inspectors' findings. "It is definitely the best record we have ever had. I am sure that the great majority of fertilizer manufacturers are endeavoring to see that every bag of fertilizer they sell contains the full guaranteed weight. Some minor deviations in weight are almost bound to occur, but I am glad to see that this year the number of bags on the short weight side is so low."



The above air-photo of the Ellis Chemical Co. plant near New Albany, Ind. was taken by Wiley W. Ellis, Vice-president of the company. Mr. Ellis served for over four years in the U. S. Air Corps during the war. As a further tie-up with aviation, the plant itself is constructed from two B-17 hangars which gives a floor space of 54,000 square feet without a post. The plant has an annual capacity of 50,000 tons of bagged goods. Ray C. Ellis, formerly of the Hopkins Fertilizer plant of the Davison Chemical Corp., is president of the new company.

April Tag Sales

Sales of fertilizer tax tags during April showed the usual seasonal decline from March. Reports of State control officials in the 15 reporting States to The National Fertilizer Association indicate that sales for April, equivalent to 1,114,000 short tons, were the lowest for the year. Compared with last April, however, when sales amounted to 914,000 short tons, there was an increase of 22 per cent; and compared with the 879,000 tons reported for April, 1946, sales were 27 per cent higher.

In the 11 Southern States sales reached 912,000 tons, compared with 788,000 tons last April and 747,000 tons two years ago. Virginia, South Carolina and Florida registered sales below those for April, 1947. Sales in the eight remaining States were above those for a year ago, with Alabama having the greatest tonnage increase.

Total sales in the four Midwestern States during April amounted to 202,000 tons, an increase of 60 per cent over a year ago. By States, all but Kansas recorded an increase over last April.

January-April Sales at New High

During the first four months of the current year, sales of fertilizer tax tags amounted to 5,208,000 tons. This tonnage represented an all-time peak for January-April sales, and was 13 per cent above the 4,591,000 tons reported for the same period last year and 4 per cent above the 4,992,000 tons reported for January-April, 1946.

Sales in the 11 Southern States, totaling

(Continued on page 24)

FERTILIZER TAX TAG SALES

Compiled by The National Fertilizer Association

State	April 1948 Tons	April 1947 Tons	April 1946 Tons	April % of 1947	January-April 1948 Tons	January-April 1947 Tons	January-April 1946 Tons
Virginia	82,006	83,676	83,857	110	380,518	344,806	372,320
North Carolina	175,754	173,862	205,133	101	977,930	965,592	1,100,330
South Carolina	75,302	82,078	70,050	110	582,618	528,008	592,560
Georgia	176,864	143,920	130,229	108	835,180	775,413	817,264
Florida	37,503	90,949	71,666	102	322,674	315,210	373,150
Alabama	158,308	89,150	78,600	126	599,348	476,750	585,650
Tennessee	78,797	46,902	18,803	110	189,906	172,774	177,894
Arkansas	37,788	24,500	27,250	80	94,421	118,500	99,200
Louisiana	28,600	16,600	23,721	111	113,017	102,180	115,531
Texas	45,012	33,404	35,289	123	211,997	172,648	170,841
Oklahoma	16,107	2,550	2,900	189	72,296	38,290	23,998
Total South	912,041	787,591	747,498	109	4,379,905	4,010,171	4,428,738
Indiana	67,099	54,422	35,123	126	289,862	229,529	202,740
Kentucky	74,699	37,623	48,293	144	285,747	198,354	199,231
Missouri	46,155	19,850	43,579	173	206,238	119,277	146,182
Kansas	13,770	14,045	4,153	135	45,975	33,943	15,362
Total Midwest	201,723	125,940	131,148	142	827,822	581,103	563,515
Grand Total	1,113,764	913,531	878,646	113	5,207,727	4,591,274	4,992,253

FERTILIZER MATERIALS MARKET

NEW YORK.

Interest in Materials for Next Season Being Shown. Demand for Top Dressing Materials Still Very Heavy. Some Price Advances Expected. Superphosphate Market Stable. Potash Contracts Reported Heavy and Producers May Allocate Production.

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, May 26, 1948.

With the current fertilizer season drawing to a close in most sections, buyers are manifesting more interest in fertilizer materials for future positions. Feed buyers have finally re-entered the market after a long lapse of time and have started to buy in a limited way to replenish their depleted inventories.

Sulphate of Ammonia

Shipments still continued slow and the demand was heavy particularly for top dressing. No prices for coming season have as yet been announced but should be out in the next few weeks.

Nitrate of Soda

Two vessels have recently arrived at Southern ports carrying nitrate of soda, which has helped the situation. Demand for top dressing is still heavy.

Ammonium Nitrate

With the recent price increase by one large producer, possible further advances may be in sight by other producers. The demand is very heavy from all sections.

Organics

Soybean meal was very firm and prices were heard around $78.00 per ton, f.o.b. Decatur, Ill. Cottonseed meal was also strong. Tankage and blood were selling at a steady price of around $6.00 per unit of ammonia ($7.29 per unit N), but supplies were rather scat and it was thought if any amount of buying appeared prices would ri e rather rapiely.

Nitrogenous Tankage

Material for quick shipment was not too easily available. Some of the recent price cutting has disappeared and a more stable market is in prospect. Offerings are light.

Fish Meal

Further sales were made at $110.00 per tin, f.o.b. fish factories for the unground scrap for summer delivery and feed buyers also entered the market and bought. A few re-sale lots appeared in different places, for the supply was small.

Castor Pomace

It was difficult to locate any material at the current price of $27.50 per ton with most producers sold up or not offering. Some re-sale material sold at a slightly higher price for prompt shipment.

Hoof Meal

Several sales were made at around $5.00 per unit of ammonia ($6.08 per unit N) f.o.b. Western shipping points, with little material offered at the present time. Higher prices are looked for shortly.

Garbage Tankage

Slightly lower prices were indicated in some sections but most material is still being shipped under contract and new contracts are expected to be made shortly.

Superphosphate

Shipments were continuing on old contracts and the market seems to be well stabilized around current prices. With the recent increase in phosphate rock and other increases in manufacturing costs, it is hard to see how much lower prices can be obtained. The Government is said to be inquiring for a large tonnage for export under the Marshall plan. The figure is said to be about 50,000 tons.

Potash

Producers have received a very large number of orders in response to recent price schedules for the coming season and will

probably be forced to allocate the material to their regular customers. Some French potash arrived at a Northern port the past week.

CHICAGO

Little Change in Organics Market with Firmer Conditions in the East. Some Improvement in West Expected.

Exclusive Correspondence to "The American Fertilizer"

CHICAGO, May 24, 1948.

There has been no change in the price level or market condition on animal proteins for the past two weeks. However, eastern markets on dry rendered tankage appear to be slightly firmer than those prevailing in the middle west and this improvement may be reflected in the midwest markets before very long.

In the east dry rendered tankage sold at $1.50 per unit of protein and, while the market in the middle west is quoted nominally at $1.30 to $1.35 per unit, most sellers are asking $1.50. Last week meat scraps sold in Chicago area rather freely at $75.00 per ton but further quantities are now held at $80.00 to $85.00 ground and sacked. Digester tankage is held at $90.00 per ton, sacked, f.o.b. midwest shipping points. Dried blood and unground wet rendered tankage is steady at $6.00 per unit of ammonia ($7.29 per unit N), and 65 per cent bone meal in bags at $65.00 per ton.

CHARLESTON

Possible Drop in Chemical Nitrogen Supply for Next Year Reported. Organics Market Quiet. Potash and Superphosphate Situation Unchanged.

Exclusive Correspondence to "The American Fertilizer"

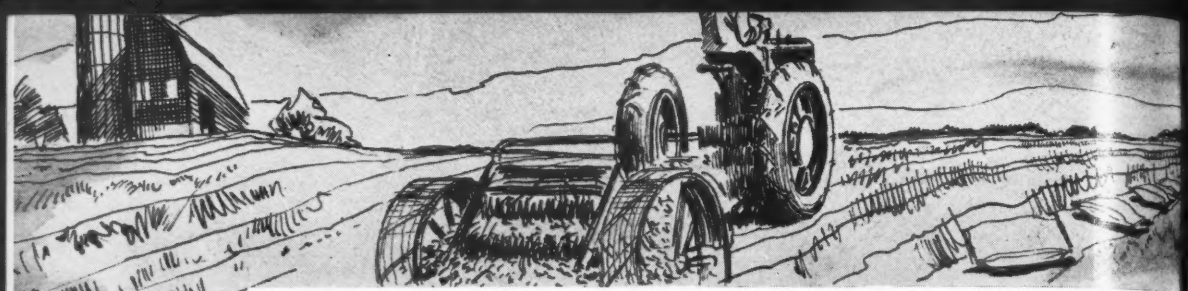
CHARLESTON, May 24, 1948.

It is reported that some buyers of mineral nitrogen have been advised that their sources of supply during the past season will not be able to furnish as much during the coming season as they did during the past season. Prospects for nitrogen supplies for the coming season are the prime worry of fertilizer manufacturers. Potash is in easier position, though demand continues strong. Superphosphate is not quite as short at this time as it was last year.

Organics.—Buying interest in organics is rather quiet though sales have been made to a good many fertilizer manufacturers for the summer and fall movement. A large number of manufacturers, however, are watching the market before purchasing. Summer shipment of domestic nitrogenous is quoted at $3.25 per unit of ammonia, $3.50 per unit of ammonia ($4.25 per unit N), and $4.00 per unit of ammonia ($4.86 per unit N), f.o.b. production point, depending on location of the producer. South American organics are still too high to interest domestic buyers.

Castor Pomace.—Sellers are in a relatively sold up position after sales were made recently at $27.50 in bags, f.o.b. production points in the East for summer shipment.

Potash.—Contract prices for the new season have been announced by practically all producers of potash. Prices are the same as for the previous season except that technical grade sulphate of potash is advanced $2.50 per ton effective June 1, 1948. List price for Trona muriate of potash is 45½ cents, basis 60 per cent K_2O, for delivery prior to May 31, 1949.



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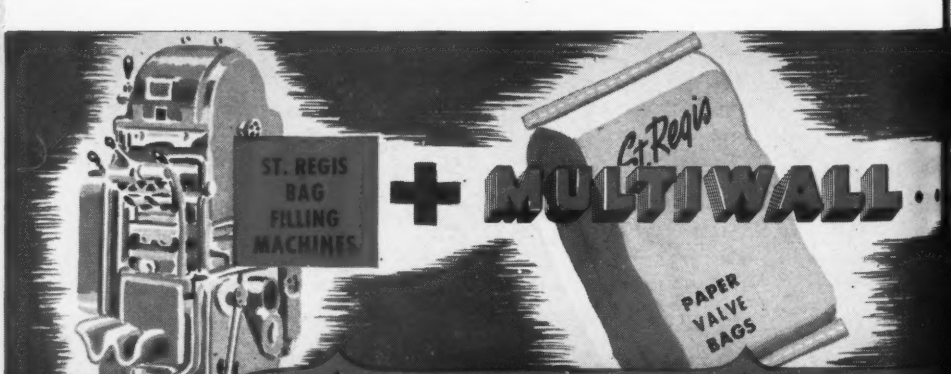

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Packaaina Svstems

Nitrate of Soda.—Demand continues excessive and although imports are reported on schedule, supply is short of demand. No change in prices has been indicated.

Sulphate of Ammonia.—The market maintains its tight position for, in spite of recent gains in production, the supply is far below the demand.

Dried Ground Blood.—Chicago market is around $6.00 per unit of ammonia ($7.29 per unit N), in bulk with interest rather slack. New York market is nominally the same.

Tankage.—Wet rendered tankage is around $6.00 to $6.25 per unit of ammonia ($7.29 to $7.59 per unit N), f.o.b. production point in New York area, with prices approximately the same in the Chicago area.

Superphosphate — Production continues steady and shipping conditions have improved in recent weeks. Prices are firm.

Phosphate Rock.—Supply conditions have shown no appreciable easement in recent weeks and as the demand exceeds output, the market is described as tight with prices firm.

PHILADELPHIA

Demand for Nitrogen Strong in Spite of Late Season. Organics Market Quiet. Superphosphate Production Seems Adequate.

Exclusive Correspondence to "The American Fertilizer"

PHILADELPHIA, May 24, 1948.

The season is several weeks late and there is still demand for chemical nitrogen. The hope is expressed that the Nitrogen Allocation System may be broadened to include anhydrous ammonia, and thus release more sulphate of ammonia for domestic use. Organics are still in a weak position.

Sulphate of Ammonia.—While the production has increased, the demand still continues with no indication of easement. The supply position is exceedingly tight, and a ready market exists for resale.

Nitrate of Soda.—Chilean continues to arrive on schedule, but there is not enough to meet the demand.

Ammonium Nitrate.—While deliveries are reported on schedule, the supply is insufficient.

Castor Pomace.—Any quotations at this time are merely nominal, as the present supply has been entirely exhausted.

Blood, Tankage, Bone Meal.—The market is nominally a little stronger, with demand not active. Blood has been quoted at $6.25 to $6.50 per unit of ammonia ($7.59 to $7.90 per unit N), per ton and tankage $5.75 to $6.00 ($6.99 to $7.29 per unit N). Bone meal is in active demand but in scant supply.

Fish Scrap.—Scrap has been sold at $110.00 per ton, with menhaden meal at $125.00 to $130.00, mostly on a when-and-if-caught basis and for not too distant delivery.

Phosphate Rock.—Production is still behind the demand, and the market is reported quite firm.

Superphosphate. — Some accumulation of stocks is reported as a result of improved production, but the market is reported rather firm.

Potash.—There is still active demand for this material but the inquiries are not now so persistent. Production in Europe is said to have increased greatly.

Chronister Appointed Southern Agronomist by Barrett

The Barrett Division, Allied Chemical & Dye Corporation, have announced the appointment of Borden S. Chronister of Raleigh, North Carolina, as Agronomist for the Southern District. Mr. Chronister, who is a graduate of the University of Tennessee, will take over the general agricultural and educational work previously handled by Leroy Donald who has recently resigned.

Walter S. Colvin will continue as Agronomist for the Northern District.

March Superphosphate Production Passes Million Ton Mark

During March, production of superphosphate at 174 plants reached a new high of 1,032,000 equivalent short tons (basis 18 per cent A. P. A.), according to reports submitted to The National Fertilizer Association and a summary of reports submitted to the Bureau of the Census. This is the first time that monthly production of superphosphate has exceeded one million tons. Compared with the previous record high of 965,000 equivalent tons, which was reached in December, 1947, production during March was 7 per cent greater; the increase in production over the previous March amounted to 16 per cent. Shipments of 645,000 tons during March surpassed those of a year ago by 11 per cent, and the amount of superphosphate used in mixed goods was also 11 per cent greater.

The major part of the increase over the former record production of December was due to stepped-up production of normal superphosphate (18 per cent A. P. A.). During March such production totaled 930,000 tons, an increase of 6 per cent over the December production mark of 874,000 tons. Production of concentrated superphosphate during March increased 11 per cent over the December figure of 34,000 tons (45 per cent A. P. A.). Production of wet base goods, amounting to 7,500 tons (18 per cent A. P. A.), was at a new peak too, but such production represented less than 1 per cent of total production.

Cumulative production for January-March amounted to 2,842,000 equivalent tons, an increase of 11 per cent over the same period last year. Total disposition and end of month stocks were also higher.

	Normal 18% A.P.A. Tons	Concentrated 45% A.P.A. Tons	Base Goods 18% A.P.A. Tons
Production:			
March, 1948	930,154	37,752	7,546
February, 1948	785,608	36,480	7,044
March, 1947	798,259	33,999	5,618
Shipments and Used in Producing Plants:			
March, 1948	1,007,991	42,022	13,612
February, 1948	822,457	38,160	8,048
March, 1947	917,737	34,586	8,776
Stocks on Hand:			
March 31, 1948	830,205	63,424	5,683
February 29, 1948	897,027	68,096	11,862
March 31, 1947	512,489	52,455	2,257

Arkell & Smiths Open New Bag Plant

Arkell & Smiths, bag manufacturers with home offices at Canajoharie, N. Y., have recently opened a new plant at Mobile, Ala., for the production of multiwall paper bags. The company is introducing a new fertilizer bag, known as "Sta-Stak," which they claim is more durable than the ordinary bag, is easier to handle and will remain stacked when piled in warehouses or railroad cars. The new bag will be manufactured at the Mobile plant and at the company's plant at Wellsburg, W. Va. The same kind of bag has been used extensively in the flour industry.

Link-Belt Office Moves From Schenectady to Albany

Link-Belt Company announces the opening of a district sales office in Albany, N. Y., with headquarters at 309-310 First Trust Company Building, 444 Broadway, Albany 7.

J. Charles Bullock, who has served as district sales manager at Schenectady since the first of the year, has been appointed district

sales manager at Albany. The Schenectady office is now discontinued.

Mr. Bullock started his Link-Belt career at the company's Dodge plant in Indianapolis in 1935, successively working in the order, pricing, estimating, application and priority departments.

He was district sales engineer at the Link-Belt Ewart plant in Indianapolis from 1942 to 1945, and district sales engineer at the company's Atlanta plant from 1945 to 1948.

West Virginia Corn Tests

In order to secure information as to adequacy of corn fertilization practices in West Virginia, a number of fertilizer trials were run in 1947. Answers to two questions were sought: (1) Are our West Virginia farmers using enough phosphate and potash on corn and (2) if they are using enough phosphate and potash, do they need to apply more nitrogen. To answer the first question, 500 or 1,000 pounds of an 0–10–10 fertilizer were plowed under in addition to what the farmer used at planting time. To answer the second question, 500 or 1,000 pounds of a 10–10–10 fertilizer were plowed under in addition to the farmers' normal application. The details of this fertilizer experiment are nicely summarized in West Virginia Mimeographed Circular No. 59.

A brief summary of 1947 results may be of interest. Based on increases in yields from the application of 0–10–10 fertilizer, it would appear that insufficient phosphate and potash to assure full use of soil organic matter supplies is quite common on many farms. In six out of nine trials profitable response to the application of nitrogen (10–10–10 fertilizer) was secured. These results suggest reconsideration of present practices in the interest of larger and more economic yields.

New Wisconsin Mixture

A new fertilizer analysis for broadcast application on certain crops developed by Wisconsin scientists has made an excellent record during the past few years. The analysis is a 6–6–18, which means that by comparison with the usual mixed fertilizers in Wisconsin it is high in nitrogen and potash, but low in phosphate. This sort of combination appears to be most efficient for broadcasting on potatoes, canning beets, and sugar beets. In 1945, for example, Berger and Truog found this new analysis the best fertilizer tested for broadcast on potatoes on two quite different soil types, Antigo silt loam and Plainfield sandy loam. On the Antigo soil, yields of 426 bushels an acre were secured with a broadcast of 1,200 pounds of 6–6–18 and a row application of 800 pounds 3–12–12. This treatment increased yields by 114 per cent over the 199 bushels secured without fertilizer, and by 81 per cent over the 265 bushels obtained without broadcast fertilizer but with 800 pounds of 3–12–12 in the row. (*Wisconsin Bulletin No. 469*).

APRIL TAG SALES

(Continued from page 14)

4,380,000 tons, were 9 per cent greater than for the same period last year. In Arkansas, sales were 20 per cent lower, but the other ten States recorded increases which ranged from 1 per cent for North Carolina to 89 per cent for Oklahoma. On a tonnage basis, sales during this period were greatest in North Carolina, with Georgia second.

The four Midwestern States had total sales of 828,000 tons, an increase of 42 per cent over the same period last year. Each of these four States showed an increase over January-April, 1947, with the increase for Missouri amounting to 73 per cent.

NATURE AND PROBLEMS OF FERTILIZING IN MODERN TIMES

(Continued from page 10)

through its iodine number, this criterion was used to identify the fat content and quality of the oil.

It is natural that more energy is required to fabricate saturated than unsaturated fatty acids from the primary products in the assimilation of carbon dioxide; because the saturated contain more hydrogen and therefore possess higher calories than the unsaturated. But on their part these unsaturated show higher reaction activities because of their more or less greater content of double bonds and for this reason are particularly valuable from a physiological, nutritional viewpoint. The modern science of nutrition knows that the reactive organic fat always contains unsaturated fatty acids, so that for proper nutrition (*54*) the fats of a high iodine number must absolutely be made available. The reserve fats of organisms valuable as a source of energy very often show a high degree of saturation. In regard to linseed oil it has been shown that it is particularly rich in saturated fatty acids when it originates from seed grown in warm climates, and that flax grown in northern latitudes produces oil of more unsaturated fatty acids.

The "outer" temperature, *i. e.*, the climate, is therefore an important factor in the formation of fats of high or low degrees of saturation. Schmalfuss further showed that the "inner" climate of plants also determines the saturation point of linseed oil. This refers to the water economy which again, as earlier mentioned, depends in a far-reaching manner for its dynamics upon the mineral nutrition of plants. He found that a low water supply to the flax plant produced conditions of hot climates under which fat formation carried reductions through to the saturated fatty acids, whereas a good water supply produced conditions of cool climates which led to the formation of unsaturated fatty acids. He could furthermore prove that hydrophilic ions, such as potash and chloride ions, promoted formation of fats of high nonsaturation with consequent high iodine number; contrarily, hydrophilic ions created conditions as in a hot climate and consequently produced first of all fats with a high degree of saturation, therefore low iodine number. Field trials by Giesecke and Schmalfuss (*55*) confirmed clearly the findings from pot experiments about the relationship of the nutrition of flax to the iodine number of linseed oil and confirmed anew that the effect of nutrients upon a high or low iodine number can be explained exclusively through the water economy and the warmth of plants respectively. In this manner it is possible to produce fats of different technical and physiological nutritional quality by varying plant nutrition.

Fertilization and Albumin Yields

It is of great importance to produce all necessary albumin for human and animal needs within our own country if possible. That is in line with good national policy on nutrition. Several years ago Selke (*56*) worked out a process to increase substantially the content and yield of albumin in our grains through a supplemental late nitrogen fertilization.

Normally, there are limits to the amount of nitrogen fertilization for grains because of the danger of lodging, and this method therefore involves the application of additional nitrogen after vegetative growth is substantially completed and ears have formed. This additional, late application of nitrogen is then utilized first of all for generic growth, for the enrichment of albuminous substances in the grains. Experiments over many years by Selke, and comprehensive cooperative experiments from research stations (*57*) resulted in increases of 2 to 5 per cent of the albumin content of summer barley, winter barley, oats, and summer and winter wheat, according to climate and quantity of nitrogen used as compared with former fertilizer practices. In many cases additional yields of grain crops of 50 kilos per hectare (45 lbs. per acre), sometimes more, were noted from late nitrogen supplemental fertilization, particularly on winter barley and oats. With this method, the albumin content can be increased 20 to 50 per cent per surface unit, and in the case of wheat an increase also in moist-gluten content. It is important that

the Selke process actually increases the pure protein content of grain and not only the nitrogen-containing substances of a non-albuminous nature, therefore the additional nitrogen has really accumulated as genuine albumin material (*58*). The yield of straw increases hardly, if any, through these late nitrogen fertilizer supplements, but the albumin content of straw is many times increased, which is important considered in relation to its value as feedstuff and as manure. The late supplemental nitrogen applications are best made in the form of nitrates; calcium ammonium nitrate particularly has been proved as suitable.

The modern science of nutrition recognizes more and more that the biological valencies of albumin compounds are essential for the level of albumin needed for keeping qualities and production yields. This points to an important problem for the future, namely, to secure through suitable nutritional measures a production of vegetable albumin, which through efforts directed to the formation of proteins of high biological value, will build albumin compounds having a definite content of such amino acids as are of particular value and importance in animal nutrition. The final goal would be to direct the production of vegetable matter through fertilizer in such a manner that, besides developing the highest possible calorie values, one would be creating and concentrating in the crops the protective foods having specific properties (albumins having certain compositions, vitamins, etheric oils and other activators). This process is also important for the creation of biochemical mineral matter.

Newer findings of different researchers lead us to suspect that important relationships exist between the potash and phosphoric acid nutrition of plants and the form of their nitrogen supply (*59*). When there is insufficient potash, it appears that the nitrogen fertilization is impaired by the use of ammonium salts. This shows that plants require for their normal course liberal potash nutrition; whereas nitrogen fertilization with nitrates has particularly bad effects when there is a shortage of phosphoric acid. Hence, in the latter case, adequate amounts of phosphate are needed. This proves once more the truth of certain fundamental laws of modern fertilization, namely, that all biologically essential nutrients must be furnished to plants, and that these nutrients must each time be present in required amounts and in correct harmonious proportions. The latest concept is that the assimilation of phosphate ions by plants appears to be retarded by chloride ions, but favored by sulphate ions (*29*).

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(To be concluded in the next issue)

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Baker & Bro., H. J., New York City
Davidson Commission Co., The, Chicago, Ill.
Huber & Company, New York City
Jackle, Frank R., New York City.
Keim, Samuel D., Philadelphia, Pa.
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

BUCKETS—For Hoists, Cranes, etc.
Hayward Company, The, New York City

BUCKETS—Elevator
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CARS AND CARTS
Atlanta Utility Works, The, East Point, Ga.
Hough Co., The Frank G., Libertyville, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind

CHEMICALS
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Commercial Solvents Corp., New York City
Davison Chemical Corporation, Baltimore, Md.
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
Lion Oil Company, El Dorado, Ark.
McIver & Son, Alex. M., Charleston, S. C.
Spencer Chemical Co., Kansas City, Mo.
Virginia-Carolina Chemical Corp., Richmond, Va.
Woodward & Dickerson, Inc., Philadelphia, Pa.

CHEMISTS AND ASSAYERS
Gascoyne & Co., Baltimore, Md.
Shuey & Company, Inc., Savannah, Ga.
Wiley & Company, Baltimore, Md.

CONDITIONERS
Arkansas Rice Growers Corp. Assn., Stuttgart, Ark.
Jackle, Frank R., New York City.
Keim, Samuel D., Philadelphia, Pa.

COTTONSEED PRODUCTS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
Jackle, Frank R., New York City.
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

CYANAMID
American Agricultural Chemical Co., New York City
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City

DRYERS
Sackett & Sons Co., The A. J., Baltimore, Md.

ENGINEERS—Chemical and Industrial
Chemical Construction Corp., New York City
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Titlestad Corporation, Nicolay, New York City

FERTILIZER (Mixed) MANUFACTURERS
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Davison Chemical Corporation, Baltimore, Md.
International Minerals & Chemical Corporation, Chicago, Ill.
Southern States Phosphate & Fertilizer Co., Savannah, Ga.
Virginia-Carolina Chemical Corp., Richmond, Va.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
Jackle, Frank R., New York City.
McIver & Son Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

FOUNDERS AND MACHINISTS
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

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Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

IMPORTERS, EXPORTERS
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Southern States Phosphate & Fertilizer Co., Savannah, Ga.
Woodward & Dickerson, Inc., Philadelphia, Pa.

INSECTICIDES
American Agricultural Chemical Co., New York City

LEAD BURNERS
Southern Lead Burning Co., Atlanta, Ga.

LIMESTONE
American Agricultural Chemical Co., New York City
Ashcraft-Wilkinson Co., Atlanta, Ga.
McIver & Son, Alex. M., Charleston, S. C.

LOADERS—Car and Wagon
Hough Co., The Frank G., Libertyville, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making and Handling
Atlanta Utility Works, The, East Point, Ga.
Chemical Construction Corp., New York City
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Ammoniating
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Elevating and Conveying
Atlanta Utility Works, The, East Point, Ga.
Hough Co., The Frank G., Libertyville, Ill.
Hayward Company, The, New York City
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Grinding and Pulverizing
Atlanta Utility Works, The, East Point, Ga.
Bradley Pulverizer Co., Allentown, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Material Handling
Atlanta Utility Works, The, East Point, Ga.
Hayward Company, The, New York City
Hough Co., The Frank G., Libertyville, Ill.
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Mixing, Screening and Bagging
Atlanta Utility Works, The, East Point, Ga.
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MACHINERY—Power Transmission
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Superphosphate Manufacturing
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

MANGANESE SULPHATE
McIver & Son, Alex. M., Charleston, S. C.

MINOR ELEMENTS
Agricultural Minerals Co., Montgomery, Ala.
Tennessee Corporation, Atlanta, Ga.

MIXERS
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

NITRATE OF SODA
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.

NITROGEN SOLUTIONS
Lion Oil Company, El Dorado, Ark.
Spencer Chemical Co., Kansas City, Mo.

NITROGENOUS ORGANIC MATERIAL
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J. New York City
Davidson Commission Co., The, Chicago, Ill.
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City.
McIver & Son Alex. M., Charleston. S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

NOZZLES—Spray
Monarch Mfg. Works, Philadelphia, Pa.

PHOSPHATE ROCK
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Virginia-Carolina Chemical Corp., Richmond, Va.

PLANT CONSTRUCTION—Fertilizer and Acid
Atlanta Utility Works, The, East Point, Ga.
Chemical Construction Corp., New York City
Sackett & Sons Co., The A. J., Baltimore, Md.
Southern Lead Burning Co., Atlanta, Ga.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.
Titlestad Corporation, Nicolay, New York City

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City.

POTASH SALTS—Manufacturers
American Potash and Chem. Corp., New York City
Potash Co. of America, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
United States Potash Co., New York City

PRINTING PRESSES—Bag
Schmutz Mfg. Co., Louisville, Ky.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.

REPAIR PARTS AND CASTINGS
Atlanta Utility Works, The, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

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SCALES—Including Automatic Bagging
Atlanta Utility Works, The, East Point, Ga.
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Stedman's Foundry and Mach. Works, Aurora, Ind.

SCREENS
Atlanta Utility Works, The, East Point, Ga.
Link-Belt Co., Chicago, Ill.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.
Sturtevant Mill Company, Boston, Mass.

SEPARATORS—Air
Kent Mill Co., Brooklyn, N. Y.
Sackett & Sons Co., The A. J., Baltimore, Md.
Sturtevant Mill Co., Boston, Mass.

SPRAYS—Acid Chambers
Monarch Mfg. Works, Inc., Philadelphia, Pa.

SULPHATE OF AMMONIA
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
Jackle, Frank R., New York City.
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

SULPHUR
Ashcraft-Wilkinson Co., Atlanta, Ga.

SULPHURIC ACID
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicaro, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Southern States Phosphate Fertilizer Co., Savannah, Ga.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

SUPERPHOSPHATE
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Davison Chemical Corporation, Baltimore, Md.
Huber & Company, New York City
International Minerals & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City.
Southern States Phosphate Fertilizer Co., Savannah, Ga.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

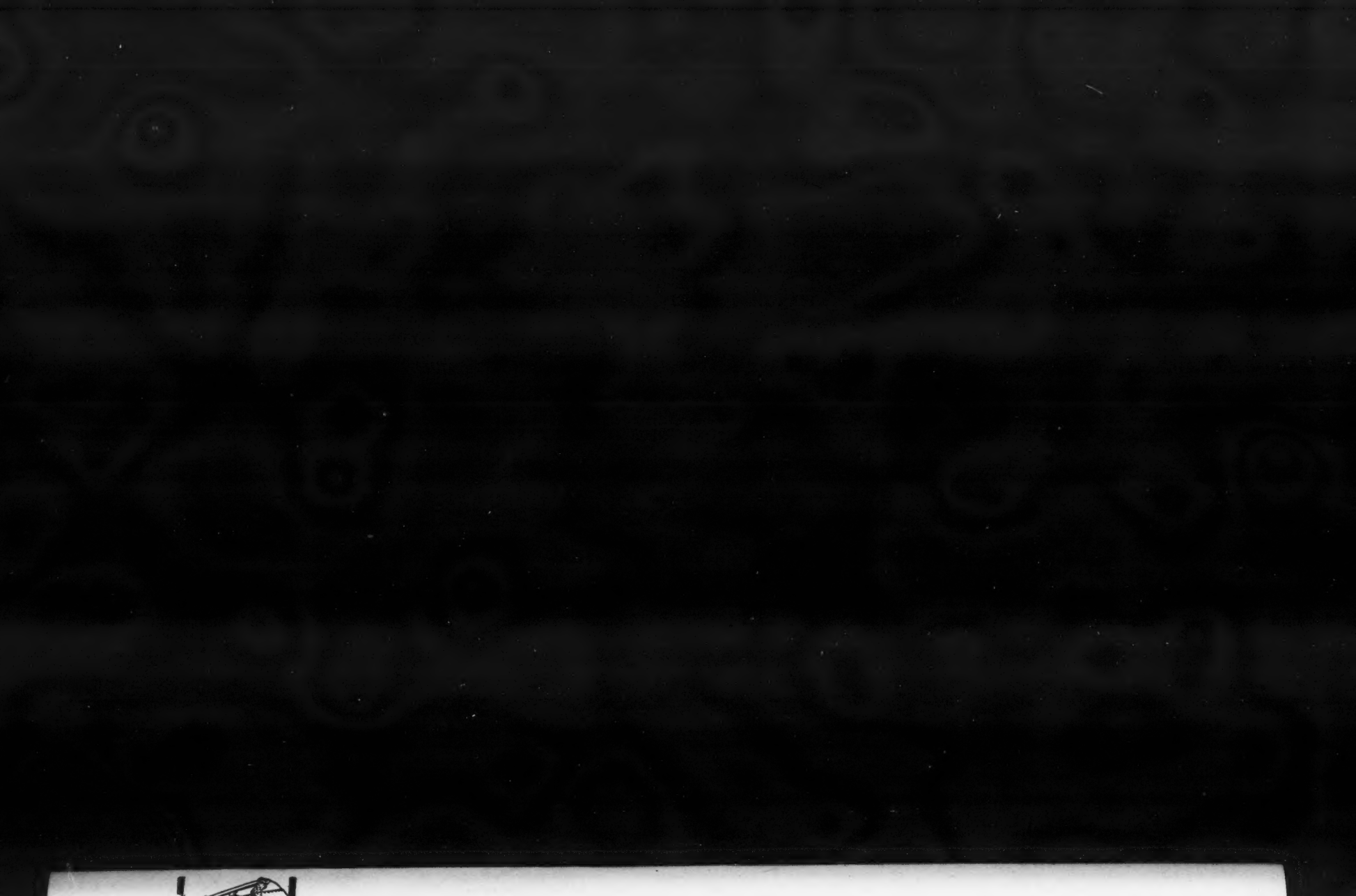
SUPERPHOSPHATE—Concentrated
Armour Fertilizer Works, Atlanta, Ga.
International Minerals & Chemical Corporation, Chicago, Ill.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Virginia-Carolina Chemical Corp., Richmond, Va.

TAGS
Keener Mfg. Co., Lancaster, Pa.

TANKAGE
American Agricultural Chemical Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City
Davidson Commission Co., The, Chicago, Ill.
International Minerals & Chemical Corporation, Chicago, Ill.
Jackle, Frank R., New York City.
McIver & Son, Alex. M., Charleston, S. C.
Woodward & Dickerson, Inc., Philadelphia, Pa.

VALVES
Atlanta Utility Works, The, East Point, Ga.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

Alphabetical List of Advertisers



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